# CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: September 10, 2004 FILE REF: 3320

TO: **Wisconsin Licensed Well Drillers**

FROM: **Mark Putra – Chief, Private Water Systems Section**

SUBJECT: **"Special Well Casing Pipe Depth Area" (Arsenic Area)**
**Outagamie County (Entire County) and**
**Winnebago County (Entire County)**

**A "Special Well Casing Pipe Depth Area" is herewith established for the entire area of both Outagamie and Winnebago Counties. Within these counties new wells must be constructed to more stringent standards as indicated below.**

The establishment of this "Special Well Casing Pipe Depth Area" is based on the potential that new wells constructed in this area to minimum Private Well Code (NR 812) specifications would be at significant risk to arsenic contamination.

This "Special Well Casing Pipe Depth Area" is established under the Department's authority provided by Section NR 812.12(3), Wis. Adm. Code (State Private Well Construction & Pump Installation Code). This area replaces the former "Arsenic Advisory Area" -- established by the Department in 1993 – and includes the entire two county area. This new "Special Well Casing Pipe Depth Area" also supersedes the four previously established arsenic "Special Well Casing Depth Areas" within these two Counties.

## EFFECTIVE DATE

**This "Special Well Casing Pipe Depth Area" is effective on October 1, 2004.**

## LOCATION

This "Special Well Casing Pipe Depth Area" includes all of Outagamie County and all of Winnebago County, Wisconsin. **(If you plan to construct wells in these two counties, the department will provide, upon request, maps describing the well construction options and the minimum casing/cement grout depth settings.)**

## CONTAMINANT

Naturally occurring inorganic arsenic.

## WELL CASING DEPTH SETTING AND GROUTING REQUIREMENTS

**Option A:** This Option is allowed east of the lines* delineated on the 'Option A' map. Within the gray shaded areas east of the line on this map, Galena-Platteville Dolomite bedrock wells may be constructed using the standard Private Well Code specifications of Sections NR 812.10 to NR 812.22. However, this option may only be used if the total well depth is not greater than 80 feet. (The Galena-Platteville Dolomite is the first bedrock layer in the eastern part of Outagamie & Winnebago Counties.) Within this Option A area, wells deeper than 80 feet may be allowed, but only with specific Department approval.
* The boundary lines delineating the areas where Option A wells are allowed are listed in detail in the appendix at the end of this document.

If the open bedrock drillhole is accidentally extended deeper, then it shall be back-filled with neat cement grout up to a level at least 10 feet above the base of the Galena-Platteville formation. In order to accomplish this back filling, a tremie pipe shall be extended to the bottom of the hole and the cement grout shall be pumped in using an approved pressure method according to the requirements of s. NR 812.26.

Note: West of the Option A boundary lines there are some areas, although small in extent, where the variations in the geology also make the shallow Galena-Platteville Dolomite bedrock well option possible. Such areas may become evident from a review of available well construction reports in a given area where you are planning to drill a well. Within these areas a specific Department approval is required for each well for this shallow bedrock option.

**Option B:** Any private well constructed within this "Special Well Casing Pipe Depth Area" -- and not constructed according to Option A -- shall be constructed with cement-grouted steel casing extending at least to the top of the Cambrian Sandstone. **(**Within this area the Cambrian Sandstone lies below either the St. Peter Sandstone or below the Prairie du Chien Dolomite, whichever happens to be present beneath any particular well site.)
The department has prepared 36 individual Township maps for these two counties. Upon request the Department will provide these maps.
For Option B wells, the minimum depth of the upper-enlarged drillhole, the casing and the cement grout is designated by the number provided within each quarter section on these maps.
Although unlikely, these minimum casing depth designations may not extend all the way down to the Cambrian Sandstone. In any case, the casing and cement grout shall be extended at least to the top of the Cambrian Sandstone.*
(Often the first 10 to 15 feet of the Cambrian Sandstone is reddish in color and can produce water with a high iron content. You may want to also extend the casing and cement grout through this top reddish layer.)
* Note: When planning the construction of a well in this two county area, it is important to review Well Construction Reports -- for the area around the specific well site. This will help you determine the depth to the top of the Cambrian Sandstone at a proposed well site. If you have difficulty in this determination, please consult with the Department's Northeast Region Drinking Water & Groundwater Specialists in Green Bay. They will assist you in this determination.

Existing bedrock wells may also be reconstructed within this area. Before contracting to reconstruct a well, you **must** first verify if the well was constructed to meet the well code requirements -- for location and construction -- that were in effect at the time of original construction. Once you have verified code compliance, you may reconstruct the well by installing a liner -- at least two inches smaller in diameter than the primary casing diameter -- provided the liner is extended from the ground surface down to at

least the top of the Cambrian Sandstone. (Reconstruction of an existing bedrock well will likely necessitate first extending the lower open bedrock drillhole into the top of the Cambrian Sandstone.) The liner shall be installed according to the requirements of s. NR 812.21(1) and shall be sealed in place with neat cement grout using an approved pressure method according to the requirements of s. NR 812.20.

## SPECIAL WELL CONSTRUCTION & DISINFECTION SPECIFICATIONS & METHODS

Within this "Special Well Casing Pipe Depth Area", private wells shall be constructed with alternate construction methods and more stringent specifications for construction, grouting and disinfection. Wells shall be constructed, cement-grouted and disinfected according to the following specifications:

1. For 6-inch diameter wells, the upper-enlarged drillhole shall have a minimum diameter of 8 ¾ inches rather than the minimum 8-inch diameter. For larger diameter wells, the upper-enlarged drillhole shall be at least 2 inches larger in diameter than the nominal diameter of the permanent well casing pipe.

2. The upper-enlarged drillhole shall be constructed using rotary mud-circulation methods or cable-tool methods. Rotary-air methods may **not** be used for this purpose. The size of the mud pit shall have a volume large enough to provide for efficient removal of drill cuttings. Further, a centrifuge sand separator shall be installed with the mud circulation system to help remove sand-sized drill cuttings that may contain arsenic-laden sulfide minerals.

3. Water used to mix the drilling mud slurry shall have a pH between 7 and 8.5. If the pH is below 7, it shall be slowly treated with soda ash to achieve a pH within this range.

4. The cement grout shall be ordered from a commercial concrete company, shall be ordered free of aggregate, and shall have a slurry density of at least 15.2 lbs./ gallon, but preferably should have a density of 15.6 lbs./gal. The grout density shall be measured with a mud balance at the well site.

5. The grout shall be adequately screened to remove any unexpected aggregate before it enters the grout pump hopper.

6. The cement grout shall be pumped into the annular space using either the "Bradenhead" or the "Grout Shoe" method and the grouting operation shall be done in a manner according to the requirements of s. NR 812.20.

7. At completion of the grouting procedure, the grout shall flow out the top of the annular space with the same density as the grout being pumped from the hopper and shall have a density of at least 15.2 lbs./gal. The grout density shall be measured with a mud balance.

8. The cement grout shall be allowed to set for at least 24 hours before the construction of the lower bedrock drillhole is commenced.

9. To avoid introduction of air (and oxygen) into the aquifers, the lower open bedrock drillhole shall be constructed using rotary-mud or "rotary-wash" drilling methods, i.e. rotary water-circulation methods. Rotary-air methods may **not** be used for this purpose. As an alternative, the lower drillhole may be constructed using cable-tool methods or with other drilling methods provided they do not inject air into the aquifer and are approved by the Department.

10. Upon completion of the well, an approved additive-free liquid chlorine (sodium hypochlorite) product shall be used to disinfect the well. Dry calcium hypochlorite products (granular or pellet type) may **not** be used. The chlorine solution may **not** have a concentration greater than 100 milligrams per liter (mg/l), and **not** more than 30 minutes of contact time in the well. After this time has elapsed, the solution shall be thoroughly flushed out of the well with water, **not** with air.

## JUSTIFICATION FOR ESTABLISHING THIS "SPECIAL WELL CASING DEPTH AREA"

Justification for establishing this "Special Well Casing Pipe Depth Area" includes the following:

1. Much of area of Outagamie and Winnebago Counties is within the former "Arsenic Advisory Area" established by the Department for northeastern Wisconsin in 1993. Within these counties many wells are contaminated with arsenic. Of the private well sampled as part of the Town-based sampling survey conducted in these counties between the years 2000 and 2003, 779 of 3,905 wells (19.9 %) had arsenic concentrations exceeding 10 parts per billion[@]. Samples from some wells contained arsenic in thousands of parts per billion. These wells have some of the highest arsenic concentrations ever found in the world.
   [@][parts per billion (ppb) is comparable to micrograms per liter (µg/l).]

2. Many well construction reports submitted for wells in this area indicate a "black sandstone" layer within the bedrock sequence. This dark layer indicates an arsenic-bearing sulfide mineral horizon in the upper layers of the St. Peter Sandstone. If the Department does not establish special well construction requirements for this area, most new wells constructed to minimum private well code standards would have a significant risk of producing water with arsenic concentrations exceeding the new health standard of 10 ppb.

3. Outagamie and Winnebago Counties are being rapidly developed with housing subdivisions. Many of these subdivisions have high-density lots. This rapid real estate development will likely necessitate the construction of many new closely spaced private wells. High concentrations of closely-spaced private wells -- constructed only to minimum Private Well Construction Code (NR 812) requirements -- would likely cause the arsenic contamination problems of this area to get significantly worse. If special casing depth requirements were not established, most new wells would likely be constructed to minimum code requirements. Such wells would have bedrock drillholes open to the mineral-laden layer that can release arsenic into the groundwater. Operation of many closely spaced wells has the potential to lower the groundwater table of this area. Such a lowering can repeatedly expose the arsenic-bearing horizon to oxygen as the water table fluctuates across this layer. The Department has found -- through research and experience -- that arsenic problems are especially prevalent in areas where there are high concentrations of wells constructed only to minimum casing depth settings. Establishment of this "Special Well Casing Pipe Depth Area" and the resultant construction of new wells with much deeper cement grouted casing settings will greatly reduce the chances new wells will produce water with elevated concentrations of arsenic.

4. Between the years 1993 and 2000 ninety wells were constructed according to Department recommended special construction specifications within the "Arsenic Advisory Area". More than eighty-five percent of these wells were successful according to the previous arsenic health standard of 50 ppb. In 2001 these special construction & disinfection methods were modified to be more effective. These modified specifications further increase the chances that new wells produce water free of arsenic. Since these updated recommendations went into effect, 131 wells have been

constructed according to these more stringent specifications. Only eight of these 131 wells (6 %) have arsenic concentrations exceeding the new arsenic health standard of 10 ppb. (None of these wells had concentrations exceeding the old standard of 50 ppb.) Even though these wells were not successful at a criterion of 10 ppb, all of them produce water with arsenic concentrations low enough to allow Department of Commerce approved treatment equipment to be effective and efficient at removing the arsenic.

5. Over a lifetime, the risk of developing cancer from consuming water containing arsenic at concentrations exceeding 10 ppb are very high compared to potential risks from other water contaminants. At the present time, scientific estimates of the risk of developing cancer from drinking the water from these wells over a lifetime is approximately three in 1,000.

6. Other health effects of consuming water contaminated with arsenic can include blood vessel damage, hypertension, nerve damage, diabetes, anemia, digestive problems and changes to the texture & color of the skin.

7. This new "Special Well Casing Pipe Depth Area" includes the former "Arsenic Advisory Area". Within this area the Department had recommended that new wells be constructed to the more stringent well construction and disinfection specifications. In addition, the Department has required more stringent well construction and disinfection specifications for wells in four previously established "Special Well Casing Pipe Depth Areas" located within these two counties. These stringent well construction specifications have been successful in providing new wells that produce water with low concentrations of arsenic. These stringent standards will not be a new concept for the residents of this area or for the Licensed Well Drillers who have constructed wells to these standards in these counties.

## APPENDIX

Construction of wells according to Option A -- i.e. Galena-Platteville Dolomite bedrock wells no deeper than 80 feet -- is allowed within this "Special Well Casing Pipe Depth Area", but only in the gray-shaded areas on the Option A map.* This gray area is described as follows:

- **Outagamie County:**
  East and South of a line delineated by the following:
  -- Highway 47 (S. Memorial Drive) starting at the Winnebago Co. line & extending north;
  -- Highway 47 (N. Richmond Street) extending north through downtown Appleton to Hwy 41;
  -- U.S. Highway 41 extending east to intersection with N. Meade Road.;
  -- N. Meade Road extending north to intersection with E. Apple Creek Road;
  -- E. Apple Creek Road extending northeast to County Highway E;
  -- County Highway E extending northeast to intersection with Co. Hwy S in Freedom;
  -- County Highway S extending east from Freedom to intersection with McCabe Road;
  -- McCabe Road extending north to intersection with Bain Road;
  -- Bain Road extending east to intersection with Co. Highway U on the Brown Co. Line.
  And East & North of a line delineated by the following:
  -- U.S. Highway 54 extending west from the Brown Co. Line to Cooper Road;
  -- Cooper Road extending north to Pearl Road;
  -- Pearl Road extending west to Smith Road;
  -- Smith Road extending north and then west to County Highway Y;
  -- County Highway Y extending north to Corput Road;
  -- Corput Road extending north to County Highway VV
  -- County Highway VV extending west to Isaar Road;
  -- Isaar Road extending north to the Shawano County Line.
- **Winnebago County:**
  East and south and of a line delineated by the following:
  -- State Highway 44 extending northeast to County Highway N;
  -- County Highway N extending east to Clairville Road;
  -- Clairville Road extending north to 9th Street Road;
  -- 9th Street Road extending east to U.S. Highway 41;
  -- U.S. Highway 41 extending northeast to County Highway G;
  -- County Highway G (and its eastern extension) east to Lake Winnebago.

* Note: Within this gray-shaded area, Option A type wells deeper than 80 feet may be allowed, but only with specific Department approval.